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VOL. 23 — No. 5

CONTENTS

Page

ORIGINAL PAPERS

Isotonicity of Contact Lens solutions. R. J. Roth 191

Effect of peripheral stimulation on central acuity. Milton N. Chodroff and Elias J. Margaretten 206

Clinical results with Feincone contact lenses. William Feinbloom 210

Notes on accommodative training procedures. Rudolph H. Ehrenberg 216

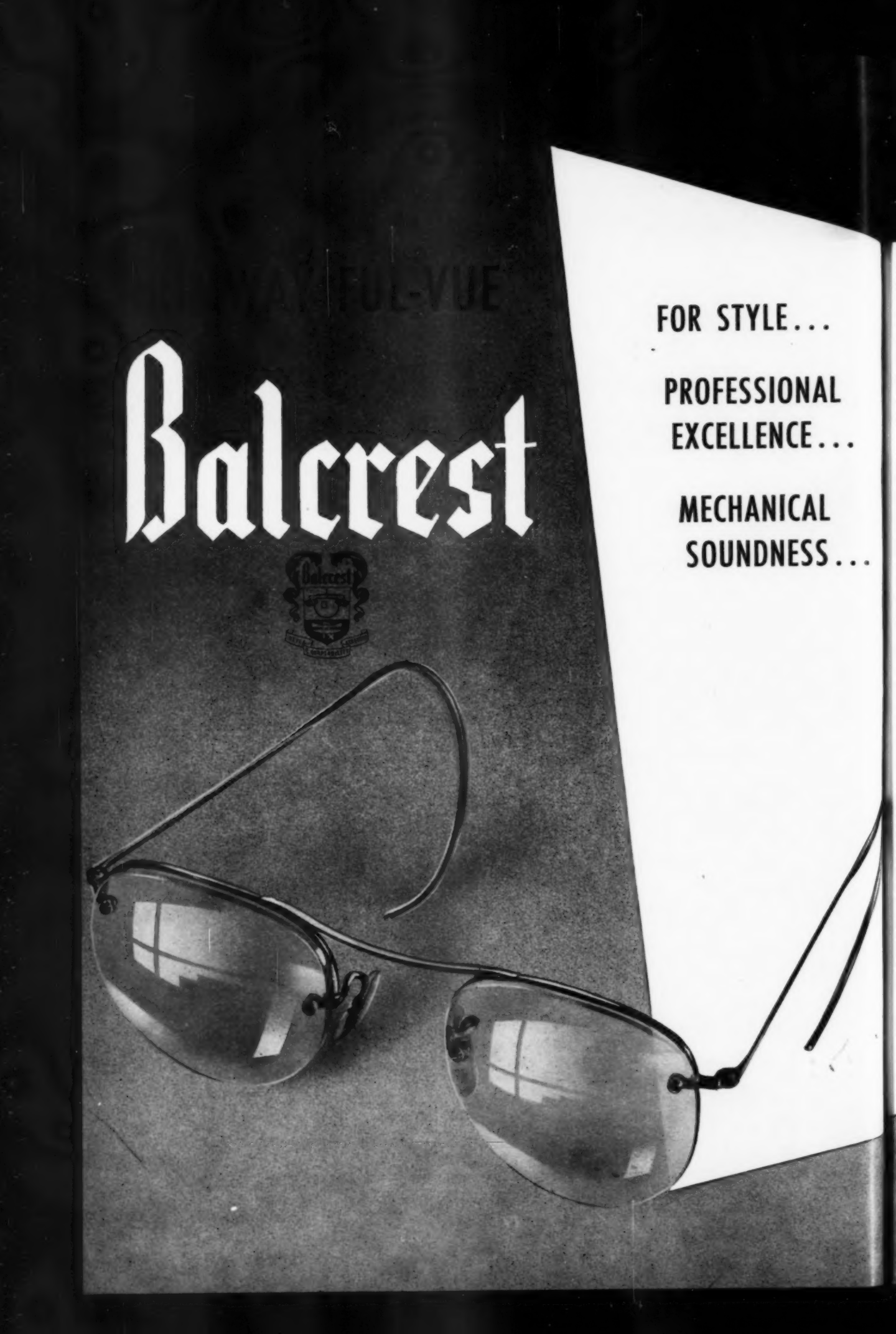
EDITORIALS

The Baltimore Project. Merguerite Eberl 222

TRANSACTIONS OF THE ACADEMY 225

BOOK NOTICES 228

ANNOUNCEMENTS 229-234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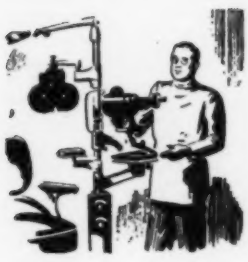

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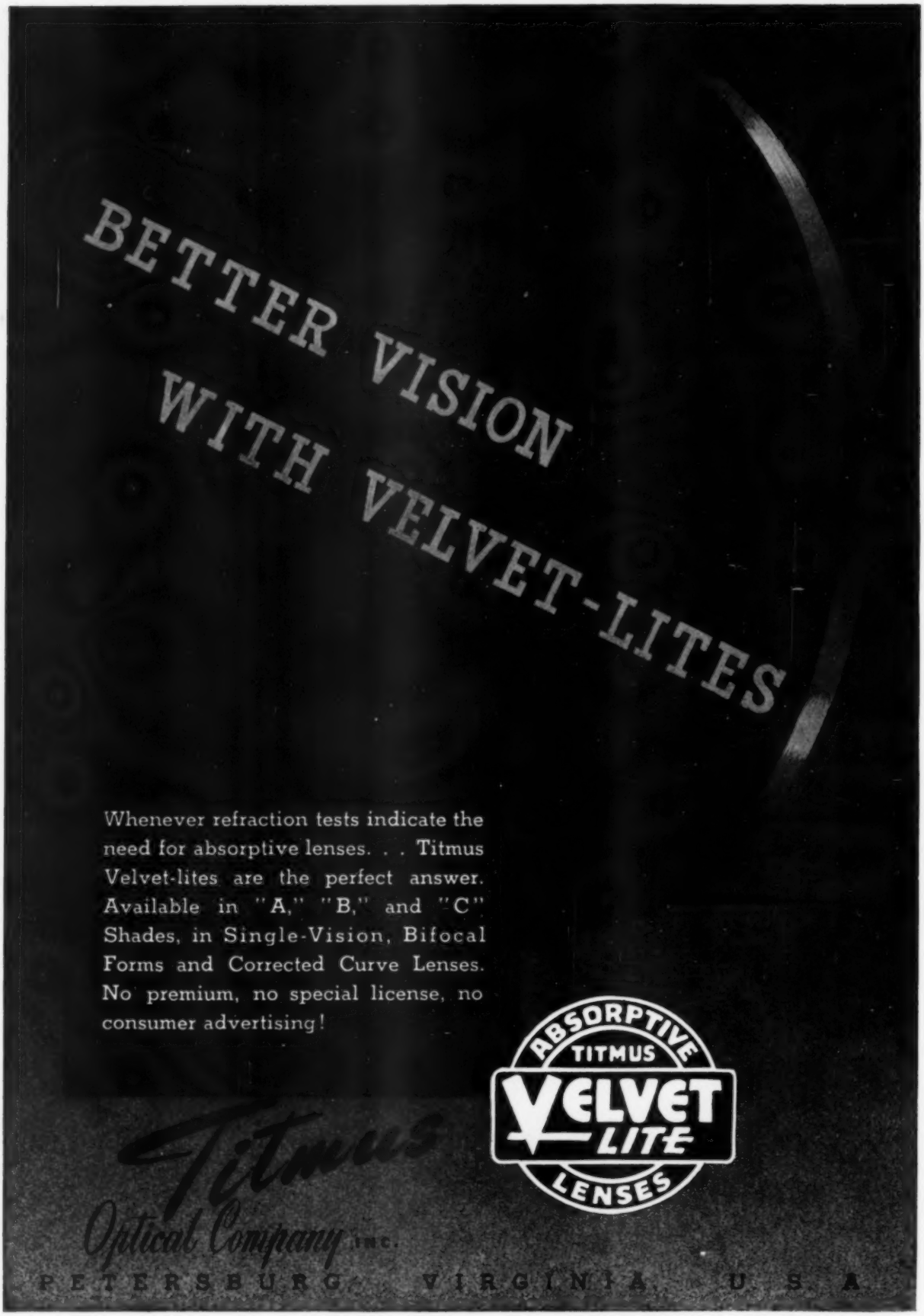
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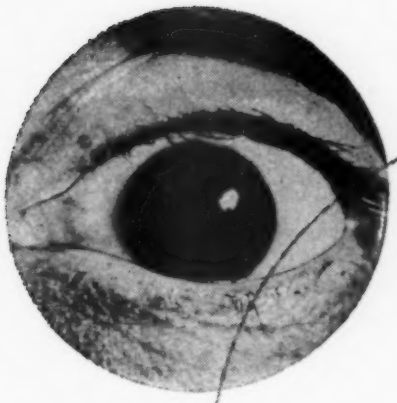

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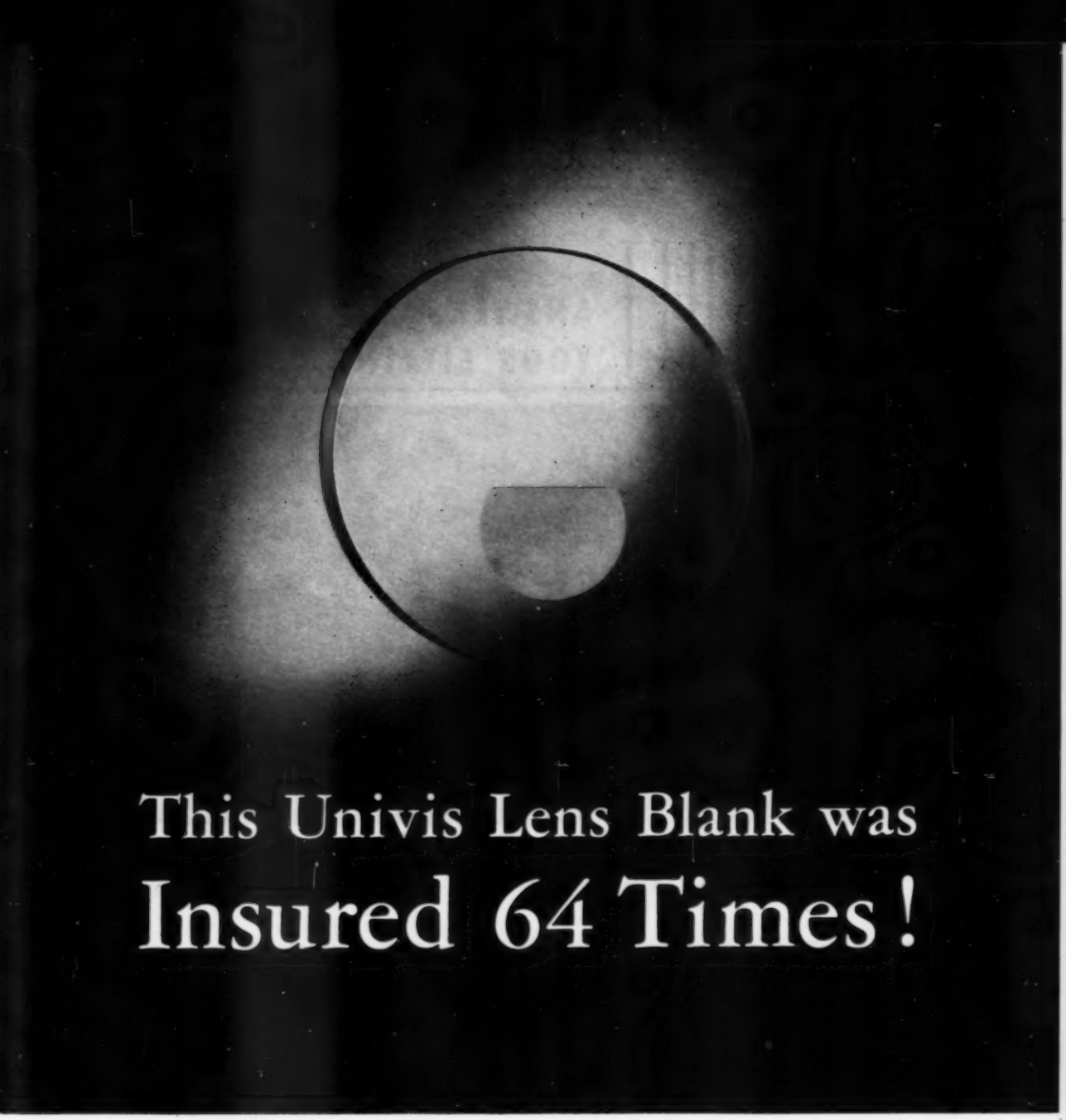

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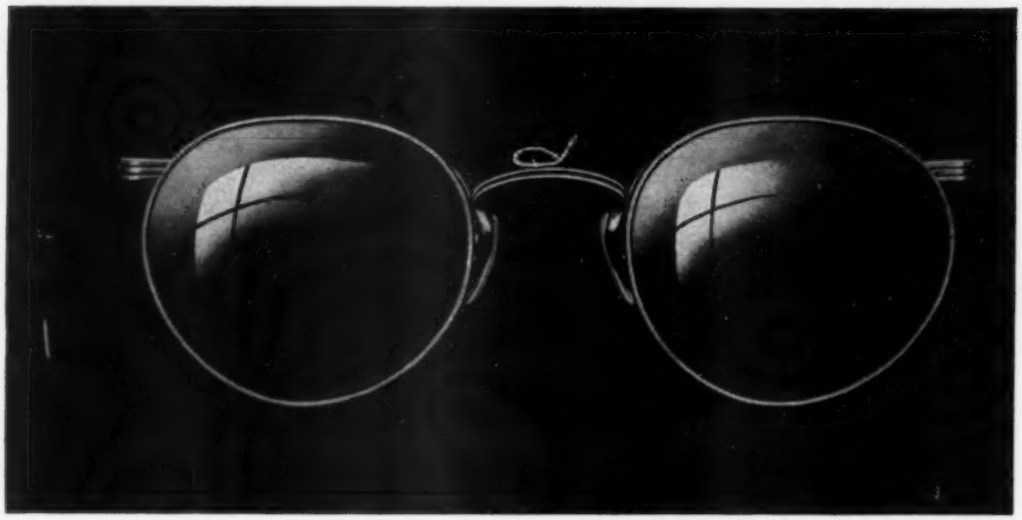

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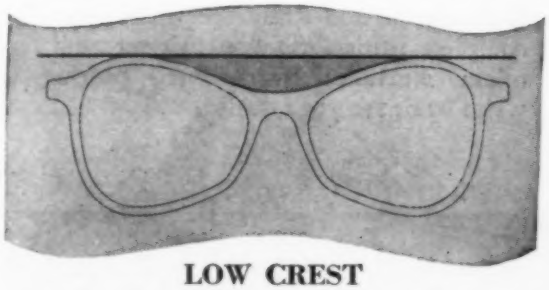

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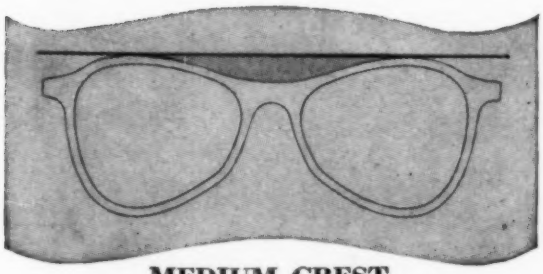

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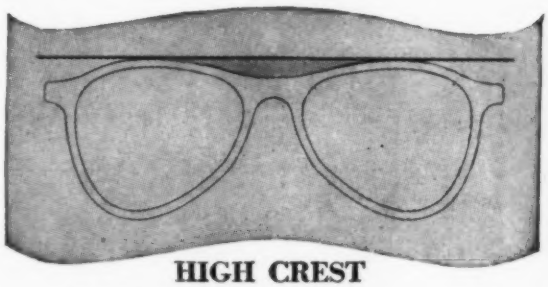

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Vol. 23 MAY, 1946 No. 5

THE ISOTONICITY OF CONTACT LENS SOLUTION*

Robert J. Roth†
Southbridge, Massachusetts

In recent years increasing attention has been focused on the composition and properties of the ophthalmic solutions which have been used as the vehicle for therapeutic drugs and as the fluid lens with contact lenses. Specifically, the characteristics which have been of interest are the reaction or pH, and the osmotic pressure of these solutions. Discussing the work of Lipschutz, von Pellathy and Schneider, Lusza, and Fischer, Gifford and Smith[1] stress Lipschutz' conclusions that the pH rather than the osmotic pressure of drug solutions introduced into the conjunctival sac was the more important factor in causing irritation. Later, Gifford[2] developed the buffer solution known as Gifford's solution which has been used frequently in contact lens work. Another buffer solution often used for contact lenses was described by Feldman[3]. Other solutions used with contact lenses have been listed by Hind[4], a pharmacist with a great deal of contact lens solution experience.

While the pH of the solution may be the more important factor so far as drug solutions are concerned, osmotic pressure is equally important in contact lens solutions. Where the time of contact of the solution with the eye is of comparatively short duration, as it is for drug solutions which are gradually washed away by the tear flow, the immediate irritation brought about is due to a large extent to the difference between the pH of the solution and the pH of the eye secretions. With contact lenses, however, once the initial, immediate source of irritation and discomfort has been alleviated by use of a solution of the proper pH and the means taken for preserving the pH by use of a buffered solution, osmotic pressure assumes a pre-eminent role. Dependent

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*Read before the Twenty-second Annual Meeting of the American Academy of Optometry, on December 11, 1945, at Columbus, Ohio. For publication in the May 1946 issue of the AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY.

†Bureau of Visual Science, American Optical Company.

directly on the osmotic pressure gradient or difference between contact lens solution and cornea, a flow of water from the solution into the cornea (hypotonicity) or a flow of water from the cornea into the solution (hypertonicity) will occur. The less the osmotic pressure gradient between cornea and solution the lower will be the rate of flow. But, and this is the important factor, there will be an unbalanced, unidirectional flow of water in the direction of the medium of higher tonicity tending to dilute the more concentrated solution. So long as a difference in osmotic pressure exists between the two media and even when such difference is relatively small, increased wearing time of the contact lenses accentuates this difference since the amount of flow even for a low osmotic pressure difference may reach the point where the patient experiences discomfort. Eventually the imbibition of excess fluid by the cornea or desiccation of the cornea by loss of fluid is such that vision is impaired, discomfort caused, the net result being the removal of the lenses from the eye. Isotonicity or the condition of balance between flow from and into the cornea is the equilibrium state where there is no net change in water content of the cornea.

Measurement of the pH of contact lens or other solutions can be accomplished in a number of ways and is a comparatively simple matter. Direct determination of the osmotic pressure, however, is not as simple. A great many difficulties preclude the measurement of the osmotic pressure directly. Other properties which are related to the osmotic pressure are usually determined. Of these the depression of the freezing point is usually the most convenient procedure. The physical theory underlying the relationship between freezing point depression and osmotic pressure has been reviewed[5] in a recent paper. Isotonic solutions show the same freezing point depression and it is this fact which is the basis for comparison of tonicity of various solutions. In agreement with accepted values, Elvin[6] reports that the lacrimal fluid has a pH of 7.4 and is isotonic with a 1.4% solution of sodium chloride and he concludes that a 1.4% solution of sodium chloride of pH 7.0 or 8.0 isotonic solutions Wells[7] makes the point that, although aqueous solutions having the same freezing point are isotonic, in dealing with the membrances of the type found in the mammalian organism, there are some solutes which may permeate the membrane or react with it. Naturally enough such cases are not considered in any presentation of osmotic pressure theory, and tonicity values have no meaning. An example of anomalous behavior encountered is the impermeability of the membrane surrounding the red blood cells or erythrocytes to plasma proteins and

its permeability to urea and other blood constituents. However, for the cornea and solutions of inorganic salts used with contact lenses, what might be called normal activity is experienced and the tonicity characteristics of the solutions are what might be expected from theoretical analysis.

A word of caution is warranted before we deal with some methods of calculating tonicity. It is possible in calculating tonicity values to express the values to as many significant figures as the calculator deems necessary. Some investigators who have calculated values for isotonic solutions have overlooked the fact that the precision of the experimental values or the approximations based thereon are accurate to fewer significant figures than the calculated results. Since the calculated results can be no more precise than the values used in the calculations, the extreme accuracy suggested by values given in some cases to four or five significant figures is misleading.

A review by Husa and Rossi[8] of many methods previously proposed for calculating the concentrations of various chemicals to prepare isotonic solutions discusses the value, limitations and accuracy of these methods. Of the methods presented in this paper it might be well to discuss the Nicola method which was used recently by Arrigoni & Fischer[9] to prepare isotonic zinc sulfate solutions.

Nicola Method

To calculate the concentration of a given substance for a solution isotonic with the lacrimal secretion Nicola proposed the use of the formula.

$$p = 0.43\ m/i$$

where

p = grams per liter of the substance required for an isotonic solution.
i = dissociation coefficient of the substance.
m = molecular weight of the substance.

For practical purposes Nicola substitutes the following values for i: 1.0 for nonelectrolytes, and 1.5, 2.0, 2.5 respectively for electrolytes and 1.5, 2.0, 2.5 respectively for electrolytes which dissociate into 2, 3 and 4 ions. A sample calculation by Arigoni and Fischer[9], using a formula based on the Nicola method to prepare an isotonic 0.125% Zinc Sulfate Solution:

$$\left[\ 0.04307 = \frac{Wa}{Ma} \times Ia\ \right] \times \frac{Mb}{Ib} = Wb$$

0.04307 = Isotonic factor of lacrimal fluid.
Wa = Weight of active ingredient in 100cc. in solution.
Ma = Molecular weight of active ingredient.
Ia = Ionization or dissociation factor of active ingredient.
Mb = Molecular weight of salt to be used to make solution isotonic.
Ib = Ionization or dissociation factor of salt to be used to make solution isotonic.
Wb = Number of grams of salt used to make 100cc. of solution isotonic with lacrimal fluid.

To prepare a 0.125% zinc sulfate solution buffered to a desired pH, two solutions, an alkaline buffer solution and an acid buffer solution are made up. The alkaline buffer solution contains 0.125 gms. of zinc sulfate and 1.000 grams of sodium acetate. The weight of potassium chloride to be added to 100cc. of the alkaline buffer solution is calculated in the following manner:

$$\frac{1.000}{82.02} \times 1.5 = 0.01829$$ (Sodium Acetate Factor, Molecular Weight, Sodium Acetate 82.02)

$$\frac{0.125}{161.43} \times 1.5 = 0.00116$$ (Zinc Sulfate Factor, Molecular Weight Zinc Sulfate, 161.43)

$0.04307 - (.00116 + .01829) = .02362$ differential factor

$$\frac{0.02362 \times 74.55}{1.5} = 1.1739$$ gm. potassium chloride to be added to 100 cc. of solution

Hence, for the isotonic alkaline buffer, a 0.125% zinc sulfate solution, the formula is

Sodium Acetate (Anhydrous) 1.0000 grams
Zinc Sulfate Anhydrous 0.1250
Potassium Chloride 1.1739
made up to 100 cc. of solution with distilled water.

The same procedure as illustrated above is followed with the acid buffer or for solutions of other strengths which may be required.

The greatest disadvantage of the Nicola method is the use of the arbitrary value established for "i" and the further inconsistency of using 1.5 as the value of "i" for electroyltes which yield 2 ions and 1.86 for sodium chloride. In the above case, for example, potassium chloride which is very similar in action to sodium chloride is assumed to have a value for "i" of 1.5 when 1.86 would be more accurate.

Besides listing various methods of calculating tonicity, Husa and

Rossi[8] suggested the use of the freezing point depressions of 1% solutions to determine isotonic solutions at any concentration. Thus a 3% solution was assumed to have a freezing point depression three times as great as a 1% solution. Values for freezing point depressions of different solutions were obtained either from the literature or by experimental determinations. The obvious disadvantage in this case is the fact that freezing point depressions do not vary linearly with concentration.

An interesting comparison of results obtained by different methods is made for a dilute solution, 1%, of cocaine hydrochloride. The amount of sodium chloride to be added to make the solution isotonic was calculated by the methods described in their paper and tabulated:

Method	Grams of NaCi Required
Experimental (F. Pt. Method)	0.74
Brown	0.75
Osmotic factor	0.73
Graphical method	0.75
Nicola	0.81
Lumiere & Chevrotier	0.78
Boehme's method	0.77

(from Husa and Rossi)

As a general rule, they state that when the concentration of the drug is greater than 0.1 molar, the freezing point method is the preferable one for calculating tonicity. For cocaine hydrochloride, a 1% solution (M. WT. 339) is about .03 molar. With a 1.4% sodium chloride solution or with other inorganic salts commonly used in contact lens solutions the concentration is likely to be higher than 0.1 molar, and according to the above rule the freezing point method should be used.

To calculate the concentrations of the various ingredients to make an isotonic solution a convenient approach is the use of the sodium chloride equivalent or coefficient proposed by Mellen and Seltzer[10] who used the Nicola method for their calculations. The sodium chloride equivalent was defined as the weight of sodium chloride which would exercise the same osmotic effect as one weight unit of the substance.

Goyan, Enright and Wells[11], emphasize the natural grouping of chemical substances of the same ionic type which have similar osmotic properties. When chemical substances are considered from a molecular rather than a percentage solution basis, these similarities in osmotic properties become more apparent.

At this point it would be well to digress for a moment to review briefly some of the methods of expressing the concentration of solute or dissolved matter in a solution. Four methods commonly used, percentage by volume, percentage by weight, a molar solution and a molal solution will be discussed.

Most commonly used in ophthalmic solutions is the percentage by volume, which is the number of grams of solute in 100 cc. of solution. For example, a 1.4% solution of sodium chloride, which is isotonic with the lacrimal secretion, contains 1.4 grams of sodium chloride in 100 cc of solution. Percentage by weight is expressed as the weight of solute in 100 grams of solution. A 1.4% by weight solution of sodium chloride would contain 1.4 grams of sodium chloride in 100 grams of solution. For dilute solutions there is usually little difference between solutions made up on a weight or a volume basis. As the concentration increases, however, more and more volume is occupied by the solute and the difference between percentage solutions by weight and volume becomes more significant.

From the chemist's viewpoint consideration of solutions on a molecular basis is the more appropriate manner of dealing with them, and in our treatment of osmotic pressure we find that the relationships between like chemical substances justify this viewpoint. On a volume basis, the molarity of a solution is used. A molar solution of a chemical compound is one which contains 1 grammolecular weight of solute in 1000 cc. of solution. For example, a 1 molar solution of sodium chloride contains 58.5 grams of sodium chloride per liter of solution; a 2 molar solution of sodium chloride 117.0 grams in a liter of solution; a 0.1 molar solution 5.85 grams per liter, etc., whereas a 1 molar solution of potassium chloride contains 74.6 grams of potassium chloride per liter of solution. Per unit volume of solution, the concentration of solute is constant in a molar solution, but the amount of solvent varies with the solute and its concentration. As an illustration of this, let us consider two solutions of sodium chloride. With water as the solvent one liter of a 0.17 molar solution of sodium chloride which contains approximately 10 grams of sodium chloride weighs 1005 grams. A liter of this solution has 995 grams or 995 cc. of water. A liter of a 1.7 molar solution of sodium chloride containing 100 grams of sodium chloride weighs 1071 grams. The water content of this solution is 971 grams or 971 cc.

To maintain a constant ratio of solute to solvent molecules a molal solution is used. A molal solution of a chemical substance is one which

contains 1 gram molecular weight of the substance disolved in 1000 grams of the solvent. A 1 molal solution of NaCl contains 58.5 grams of sodium chloride per 1000 grams or 1000/18 = 55.5 mols of water; a 0.1 molal solution, 0.1 mols per 55.5 mols of water.

It is usually easier to make solutions up on a volume rather than a weight basis, hence the prevalence of the use of % by volume and molar solutions over % by weight and molal solutions. For our purpose in the discussion of osmotic pressure properties, molal solutions are the more accurate and the values used later will be molal lowering of the freezing point. For dilute solutions of the type used in contact lenses, little error is introduced by direct conversion of molal to molar or of % by weight to % by volume, or vice versa.

An analysis of freezing point depression data on the basis of molecular proportions reveals the relationship between chemical compounds of the same ionic type. This relationship is revealed by the formula for the cryoscopic constant or molal freezing point depression which is given below.

$$K = \frac{\Delta T}{M}$$

where

K = molal freezing point depression in °C.

Δ T = depression of the freezing point for a specific concentration of solute

M = concentration of solute expressed as molality

The value of K does not vary much with changes in concentration and salts of the same ionic type tend to have the same molal freezing point depressions. Below, Table 1 shows the molal freezing point depressions of salts commonly used in contact lens solutions.

TABLE I—MOLAL FREEZING POINT DEPRESSIONS (I.C.T.[12])

Sodium Chloride		Sodium Carbonate	
Molality	K	Molality	K
.001	3.66	.01	5.12
.01	3.604	.02	4.93
.1	3.478	.04	4.73
.20	3.424	.07	4.55
.40	3.28	.10	4.44
		.20	4.17
		.40	3.88
Potassium Chloride		**Sodium Bicarbonate**	
Molality	K	Molality	K
.001	3.66	0.1	3.65
.002	3.658	.2	3.51
.005	3.648	.4	3.26
.01	3.610	.7	3.02
.02	3.566		
.05	3.503		
.10	3.451		

Boric Acid		Sodium Borate	
Molality	K	Molality	K
0.05	2.0	.015	10.4
.40	2.0	.02	10.0
		.04	8.96
		.07	8.0
		.10	7.2

Goyan, Enright and Wells[11] assigned an average molal freezing point depression value to similar ionic types and classified them on this basis (Table II).

TABLE II—CLASSIFICATION BASED ON AVERAGE MOLAL FREEZING POINT DEPRESSION

Molal Freezing Point	Ionic Type	Examples
1.9	Nonelectrolytes	Sucrose, dextrose, glycerin
2.0	Weak electrolytes	Boric acid, citric acid
2.0	Di-divalent electrolytes (two ions, polyvalent anion)	Magnesium sulfate, zinc sulfate
3.4	Uni-univalent electrolytes (two ions, univalent anion)	Sodium chloride, potassium chloride, silver nitrate
4.3	Uni-divalent electrolytes (three ions, polyvalent anion)	Sodium carbonate, sodium phosphate (Na_2HPO_4)
4.8	Di-univalent electrolytes (three ions, univalent anion)	Calcium chloride, zinc chloride, magnesium chloride
5.2	Uni-trivalent electrolytes (four ions, trivalent anion)	Sodium citrate
6.0	Tri-univalent electrolytes (four ions, univalent anion)	Aluminum chloride, ferric chloride
7.6	Tetraborates	Sodium borate, potassium borate

For the purposes of calculation, the sodium chloride coefficient or equivalent which is the weight of sodium chloride which would exert the same osmotic effect as a unit weight of the substance is used. This coefficient or equivalent may be derived from the molal freezing point formula given above, and the value of the coefficient is given by the expression

$$E = \frac{K}{MW} \frac{(58.45)}{(3.44)} = 17.0 \frac{K}{MW}$$

where

E = the sodium chloride equivalent of the substance.

MW = the molecular weight of the substance

K = the molal freezing point depression of the substance

58.45 and 3.44 are the values of molecular weight and freezing point depression for sodium chloride.

Use of the sodium chloride coefficient is especially valuable when

more than one compound is to be present in the final solution. For osmotic pressures of solutions as well as for gases for which it was originally derived, Dalton's Law of Additive Pressures applies. This states that the osmotic pressure of a solution is equal to the sum of the osmotic pressure of all the solutes in solution. Rather than the average molal freezing point depressions which were used previously, it is possible to use the accurate freezing point depressions listed by the International Critical Tables[12] and to calculate the tonicity of any solution to a greater accuracy for any specific concentration of solute.

To prepare an isotonic solution, the weight of each substance present in a definite volume is multiplied by the respective E. value. The sum of these products is subtracted from the weight of sodium chloride required to make the original volume of distilled water isotonic and the result of this subtraction is then the amount of NaCl to be added to render the solution isotonic.

One sample calculation will show how Goyan, Enright and Wells used the sodium chloride equivalent to make a solution isotonic. A prescription calling for

Ephedrine sulfate	0.60	
Chlorbutanol	0.12	
Distilled water	30.0	cc to be made isotonic with blood serum .9% NaCl

For 30 cc. of solution a .9% sodium chloride concentration requires 0.27 grams of NaCl.

Calculation

Ephedrine sulfate, M.W. 428.5, K = 4.3

$$E = 17.0 \times \frac{4.3}{428.5} = 0.171$$

or

1 gram of Ephedrine sulfate is equivalent to 0.171 grams of sodium chloride.

Hence 0.60 grams are equivalent to 0.171 x 0.60 = .102 grams of NaCl.

For Chlorobutanol,

$$\text{MWT. } 177.5, \quad K = 1.9, \quad E = 17 \times \frac{1.9}{177.5} = 0.182$$

0.12 grams are equivalent to 0.182 x .12 = .022

0.102
0.022
0.124

To render the solution isotonic with a .9% sodium chloride solution for 30 cc.

.270 — .124 = .146 grams of sodium chloride are necessary.

Feldman's and Gifford's Buffer Solutions

How do the Feldman's and Gifford's solutions used for contact lenses measure up in isotonicity as calculated by these methods?

A. Feldman's Solution

Feldman's buffer solution is made by mixing specified volumes of an acid and an alkaline solution.

Acid Solution

Boric Acid	12.4 grams
Sodium Chloride	8.4 grams

Alkaline Solution

Distilled water up to 1000 cc.	
Sodium Borate (Borax)	19.1 grams
Sodium Chloride	11.7 grams
Distilled water up to 1000 cc.	

To obtain solutions of various pH values, the acid and alkaline solutions are mixed as shown

TABLE III—COMPOSITION OF FELDMAN'S SOLUTION

pH	Acid Solution	Alkaline Solution
7.0	30.0 cc.	1.75 cc.
7.2	30.0	2.25
7.4	30.0	3.75
7.6	30.0	5.25
7.8	30.0	7.75
8.0	30.0	11.0
8.2	30.0	14.0
8.4	30.0	18.0
8.6	30.0	30.0
8.8	30.0	45.0

Instead of using the stock alkaline and stock acid buffer solutions to make up the desired pH, the supplier of the solutions usually furnishes the patient with a tablet containing the necessary salts. When the solution is needed, this tablet is dissolved in 100 cc. of water and the resulting solution used with the patient's contact lenses. It is a simple matter to calculate the values of dry salts necessary in such tablets. These have been calculated and are shown below.

TABLE IV—WEIGHTS OF SALTS—FELDMAN'S SOLUTION

pH	Boric Acid	Sodium Chloride	Borax
7.0	1.172 g.	.858 g.	.105 g.
7.2	1.153	.863	.131
7.4	1.102	.877	.212
7.6	1.056	.889	.284
7.8	.985	.908	.392
8.0	.907	.929	.512
8.2	.845	.945	.608
8.4	.775	.964	.716
8.6	.620	1.005	.955
8.8	.310	1.088	1.433

To calculate the tonicity of each of these solutions, the sodium chloride equivalent of each solution was determined. The molal freezing point depressions used were, for

Boric Acid, K = 2.0

Sodium Chloride, K = 3.44

Borax, K = 10.4 for molalities of Borax of .0028 to .016
= 10.0 for molalities of .019 to .025
= 9.0 for molality of .038

The calculations may be summarized by the following tabulation

TABLE V—SODIUM CHLORIDE EQUIVALENTS OF SALTS—FELDMAN'S SOLUTION

pH	Boric Acid		Sodium Chloride		Borax	
	Weight	E	Weight	E	Weight	E
7.0	1.172	.645	.858 g.	.858	.105 g.	.049
7.2	1.153	.634	.863	.863	.131	.061
7.4	1.102	.606	.877	.877	.212	.098
7.6	1.056	.581	.889	.889	.284	.131
7.8	.985	.542	.908	.908	.392	.181
8.0	.907	.499	.929	.929	.512	.237
8.2	.945	.465	.945	.945	.608	.282
8.4	.775	.426	.964	.964	.716	.319
8.6	.620	.341	1.005	1.005	.955	.426
8.8	.310	.171	1.088	1.088	1.433	.575

For Borax, there is somewhat more variation of the molal freezing point depression with changing concentration than is shown in the other substances. In all concentrations used, the value for K is greater than the average value of K suggested for tetraborates. The values used for the different concentrations of Borax are indicated in Table 6.

TABLE VI—VALUES OF K FOR BORAX FOR VARYING CONCENTRATIONS

pH	Weight	Molaity	K
7.0	.105 g.	.0028	10.4
7.2	.131	.0034	10.4
7.4	.212	.0056	10.4
7.6	.284	.0074	10.4
7.8	.392	.010	10.4
8.0	.512	.013	10.4
8.2	.608	.016	10.4
8.4	.716	.019	10.0
8.6	.955	.025	10.0
8.8	1.433	.038	9.0

B. Gifford's Solution

Acid Solution

Potassium Chloride	7.4 grams
Boric Acid	12.4 grams
Potassium Chloride	7.4
Distilled water to 1000 cc.	

Alkaline Solution

Sodium Carbonate	21.2 grams
Distilled water to 1000 cc.	

For the various pH values, the solutions are to be mixed in the following manner:

TABLE VII—COMPOSITION OF GIFFORD'S SOLUTION

pH	Acid Solution	Alkaline Solution
7.0	30.0 cc.	0.5 cc.
7.2	30.0	1.0
7.4	30.0	1.25
7.6	30.0	1.5
7.8	30.0	2.0
8.0	30.0	2.5
8.2	30.0	3.0
8.4	30.0	4.0
8.6	30.0	5.0
8.8	30.0	6.5
9.0	30.0	8.0

To make up tablets for 100 cc. of solution, the following weights of salts should be used:

TABLE VIII—WEIGHTS OF SALTS—GIFFORD'S SOLUTION

pH	Boric Acid	Potassium Chloride	Sodium Carbonate
7.0	1.220 g.	.728 g.	.035 g.
7.2	1.200	.716	.068
7.4	1.190	.710	.085
7.6	1.181	.705	.101
7.8	1.163	.694	.133
8.0	1.145	.683	.163
8.2	1.127	.673	.193
8.4	1.094	.653	.249
8.6	1.063	.634	.303
8.8	1.019	.608	.378
9.0	.979	.584	.446

A summary of the calculations in tabular form

TABLE IX—SODIUM CHLORIDE EQUIVALENT OF SALTS—GIFFORD'S SOLUTION

pH	Boric Acid		Potassium Chloride		Sodium Carbonate	
	Weight	E	Weight	E	Weight	E
7.0	1.220	.671	.728	.571	.035	.026
7.2	1.200	.660	.716	.561	.068	.051
7.4	1.190	.655	.710	.557	.085	.064
7.6	1.181	.650	.705	.553	.101	.076

7.8	1.163	.640	.694	.544	.133	.100
8.0	1.145	.630	.683	.535	.163	.123
8.2	1.127	.620	.673	.528	.193	.146
8.4	1.094	.602	.653	.512	.249	.188
8.6	1.063	.585	.634	.497	.303	.228
8.8	1.019	.560	.608	.477	.378	.285
9.0	.979	.538	.584	.458	.446	.336

To determine the sodium chloride equivalent of the solution at any pH, the sodium chloride equivalents of the consituent solutes are added. If a 1.4% sodium chloride solution is accepted as isotonic with the lacrimal secretions then Feldman's solution is hypertonic and Gifford's solution hypotonic (expressed as per cent sodium chloride) to the extent shown in Table 10.

TABLE X—TONICITY OF FELDMAN'S AND GIFFORD'S SOLUTIONS

pH	Feldman's Solution		Gifford's Solution	
	Tonicity	Hypertonic by	Tonicity	Hypotonic by
7.0	1.552%	.152%	1.268%	.132%
7.2	1.558	.158	1.272	.128
7.4	1.581	.181	1.276	.124
7.6	1.601	.201	1.279	.121
7.8	1.631	.231	1.284	.116
8.0	1.665	.265	1.288	.112
8.2	1.692	.292	1.294	.106
8.4	1.709	.309	1.302	.098
8.6	1.772	.372	1.310	.090
8.8	1.834	.434	1.322	.078
9.0	. . .	. . .	1.332	.068

Adjustment of the tonicity of these solutions is accomplished simply enough by using more or less of the neutral salt, potassium chloride or sodium chloride, as the case may be. Reduction or increase of the quantity of neutral salt will not effect the pH of the solution. Based on the type of tonicity calculations shown above the composition of tablets to make 100 cc. of solution for use with contact lenses should be that listed below to yield the prescribed pH and a tonicity equivalent to a 1.4% sodium chloride solution.

TABLE XI—SUGGESTED COMPOSITION OF FELDMAN'S SOLUTION

pH	Boric Acid	Borax	Sodium Chloride
7.0	1.172 g.	.105 g.	.706 g.
7.2	1.153	.131	.705
7.4	1.102	.212	.696
7.6	1.056	.284	.688
7.8	.985	.392	.677
8.0	.907	.512	.664
8.2	.845	.608	.653
8.4	.775	.716	.655
8.6	.620	.955	.633
8.8	.310	1.433	.654

TABLE XII—SUGGESTED COMPOSITION OF GIFFORD'S SOLUTION

pH	Boric Acid	Sodium Carbonate	PotassiumChloride
7.0	1.220 g.	.035 g.	.897 g.
7.2	1.200	.068	.879
7.4	1.190	.085	.869
7.6	1.181	.101	.860
7.8	1.163	.133	.842
8.0	1.145	.163	.825
8.2	1.127	.193	.809
8.4	1.094	.249	.778
8.6	1.063	.303	.749
8.8	1.019	.378	.708
9.0	.979	.446	.671

When the solutions are made up from stock solutions as described by Feldman and Gifford, the tonicity of the stock solutions may be adjusted so that any mixture of the acid and alkaline solutions will combine to give a solution isotonic with a 1.4% sodium chloride solution.

Summary

Disagreeable sensations experienced by patients when solutions were dropped into the conjunctival sac or on the cornea were at first assumed to be caused by osmotic pressure imbalances. Later, a number of investigators showed that the immediate discomfort was more intiately related to the hydrogen ion concentration. However, as a result of the stressing of the pH of these solutions, the importance of the tonicity of these solutions has often been overlooked. Especially for contact lenses where the solution used is associated with the cornea for relatively long periods of time as compared with drug solutions, control of the tonicity of the solution is of prime importance.

Of the many methods of calculating the tonicity of a specific solution, the one employing the sodium chloride coefficient or equivalent gives the more accurate results. The tonicities of Feldman's and Gifford's solutions are calculated and certain revisions in the neutral salt constituents are suggested to make these solutions isotonic with a 1.4% sodium chloride solution.

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THE EFFECT OF PERIPHERAL STIMULATION ON CENTRAL ACQUITY*

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If, from the very outset, we had a common understanding of the term Visual Acuity and what it implies, any misconceptions that might arise as a result of this paper would be eradicated. Tcherning's definition of Visual Acuity, is the smallest angle under which two points can be distinguished from each other. Hooke, later corroborated by Helmholtz, claimed that when a double star could be distinguished or recognized as such . . . then the interval must correspond to 1′ of arc; and that, that was to be considered as the measure of Visual Acuity. Snellen, then evolved his test chart wherein each test letter subtended an angle of 5′ of arc and the width of each limb of the letter subtended an angle of 1′ of arc.

According to our present methods of sight testing, we, therefore, accept as normal the Snellen rating of 20/20. In our own minds, however, we must make certain reservations as to what we must accept as normal acuity. It is not difficult to conceive of an individual whose best attainable acuity is less than 20/20 . . . let us say 20/40. Shall we therefore claim that this individuals vision is not normal for him? The rating of 20/40 may be normal for this individual since this is his best attainable vision; but on the other hand, someone else may be capable of securing a visual acuity of 20/15. In the latter case, if vision dropped to 20/40 and then could be brought up to 20/15 by whatever measures may be necessary, then, we must consider 20/15 as the normal acuity. The question of normalcy then evolves into a matter of relativity or relationship as to what is normal for any particular individual and therefore, it becomes impossible to lay down a so-called yard stick and attempt to fit individuals into it.

The problem of lowered acuity from what ever point that may be considered normal for any individual is responsible among other factors to various refractive errors or anomilies of the eye. Generally, we start life with a marked hyperopic condition and as we grow older

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we begin to show a myopic trend. The amount of hyperopia decreases in relation to body growth and the necessary metabolic changes that must take place. These changes become more or less stabilized during the early teens. However, in some individuals, we find that the myopic trend progresses at a rate that is greater than normal so that we are shortly dealing with an eye that is myopic in every aspect; inability to see clearly in the distance, long anterior-posterior diameter of the eyeball, deep physiological cupping as well as retino-choroidal changes typical of the advanced myope.

While it is true that in certain cases, of shall we say, the retarded hyperope, we do find a lowering af acuity, I believe it best to consider the myope in this paper, since the myope is the one that has the truly genuine complaint of poor vision in the distance and moreover, since the myope is the one that is always looking for the lost fountain of youth that will enable him or her to see clearly in the distance and thus become less dependent upon spectacles.

To completely understand the picture, we must realize that the visual apparatus from a receptor point of view is composed of two entirely separate and yet mutually dependent entities. I refer to the rods and the cones, the two types of receptor nerve elements that compose the retina. Each type of nerve element here has its own specific function to perform in the act of vision and yet they are mutually independent of each other. The coné elements have to do with daylight vision and it is as a result of these specific receptors that we enjoy fine visual acuity. The cones have a greater degree of sensitivity and from a qualitative standpoint have a sharper sense of discrimination than the rods. It is because of the cone elements that we have a sense of color vision. The sense of stereoscopic ability is a factor common to both rods and cones but is much more highly developed in the cones than in the rods. Anatomically, the cones are all practically concentrated in one tiny area of the retina, the fovea, while the rods are located over the remaining part of the retina. The rods have to do with night vision. As dusk or twilight approaches, the cones cease to function and the rods take up the burden of vision. That is why, at night we do not have the sharp sense of detail that we have during the day, again, that is why we lose our sense of color vision at night. But, then, rod vision is responsible for our being able to detect moving objects far to the side of us while we are looking straight ahead during our ordinary daylight visual acts.

From an anatomical standpoint, each cone element has its own single bipolar nerve cell that will carry the light sensation to the nerve

elements on its way to the brain; but the rods have an entirely different set-up. One bipolar nerve cell may be in direct communication or contact with a considerable number of rods, so that, we may have a summated effect, in that many stimulated rods will feed sensation to one bipolar cell and thus send along a stronger sensation.

Experimentally, it has been proven that highly stimulated extra foveal areas of the retina augment the sensation carried by retinal elements composing the fovea, thus resulting in an increase of visual acuity. We have found it possible among myopes of low degree to increase their resolving power or acuity so that they may enjoy a normal vision, as it is commonly thought of, without spectacles. Myopes of high degree may have a corresponding increase of acuity, but purely as a percentage factor.

During the course of the treatments, these individuals with lowered acuity are asked to fixate a specific target. This gains foveal attention. With foveal attention thus held, the peripheral areas of the retina are then stimulated by various patterns and designs composed of monochromatic green. In a short while these patterns and designs begin fading and reappearing in odd fashion as the after imagery effects takes place. Care must be taken that we stay within the fatigue point and that stimulation at any one period be given only until the fading phenomena takes place. Now if we interpose a Snellen chart before the patient we will find that an increase in acuity will take place due to a peculiar vibratory and ballooning effect upon each object fixated. The improvement in acuity at any one sitting seems to be dependent upon the type of stimulant given that will produce the greatest apparent fading or ballooning phenomena.

Peripheral stimulation, in itself, does not give us a permanent effect in so far as increase in acuity is concerned. Other phases of training must be performed in order to augment and make permanent those improvements brought about by peripheral stimulation. Peripheral stimulation, however, does have this effect in that after a treatment has been given to a subject, the subject experiences phases of remarkable clarity of vision followed by blurring. This phenomena may be maintained or carried over for a period of time comprising several hours to several days dependent upon the intensity of stimulation given and secondly upon the keyed-up condition of the subject himself.

The effect of peripheral stimulation on central vision can very easily be demonstrated with such things as Plateau's rotating spiral and the green concentric rings. The after image effect is one of blowing up

and a nearness sensation to the extent that distant objects become larger and more distinct. One can readily understand why this takes place by studying the anatomical relationship between the rods, cones and the bipolar cells of the retina as described in the previous paragraphs of this paper. For further emphasis, we know that the rods are predominant in the peripheral areas of the retina. We also know that many rods are directly connected with single bipolar cells as distinguished from the individual connections of the cones with their respective bipolar cells. This sort of an arrangement lends towards a summative effect in the bipolar cells which in turn may bounce back or return the sensation to foveal area cones and thus serve to re-enforce stimulus to central vision. Therefore, it can be seen that the cones alone at the fovea draw or collect a limited amount of energy-stimulus into their respective bipolar cells, while the rods collect a great deal more energy-stimulus because so many more elements feed into a single bipolar cell.

For years illuminating engineers have been studying the problem of contrast in illumination as it effects reading ability and fatigue thresholds. It is known that if there is too great a difference between illumination of the surrounds and that of the fixation area, then visual fatigue sets in very early. Should the surrounds be almost as equally illuminated as the fixation area you will then have ideal illumination. This is true because the peripheral areas of the retina are better stimulated and can therefore re-enforce the foveal stimulation for better vision and thus induce less effort upon the brain centers for interpretation. The retina merely acts as a receiving center, while the visual centers of the brain interpret the stimulus. It is the brain that is fatigued rather than the eyeball, when improper interpretation of a poor central stimulus is the order of seeing.

In conclusion, a fair question to ask at this point is . . . What types of cases are amenable to this form of training? Theretically, the answer can only be . . . any and every case may be trained except those cases having a central scotoma or diseased nerve element area in and around the macula. As can be expected, results termed almost miraculous can be obtained with cases having fairly low refractive errors. In those cases with high refractive errors a proportionate change takes place but the patient is still left with a fairly low acuity. These types of cases are discouraged from taking treatment for this reason.

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CLINICAL RESULTS WITH FEINCONE CONTACT LENSES*

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DESCRIPTION OF THE FEINCONE CONTRACT LENS SERIES.

The individual contact lens is an all plastic, fully transparent one-piece lens. It is composed of three sections. (1) Corneal. (2) Cone. (3) Temporal Radius.

The function of the polished corneal section is to provide the necessary refractive correction.

The function of the cone or truncated conical section is to provide the bearing surface for the entire contact lens on the bulbar conjunctiva of the eye. The angle of the cone is the first variable and in the trial case series is present as 43, 46 and 49 degrees. The angle of the cone is defined as one-half the included angle of the cone if continued to its apex. The first two numbers inscribed on the temporal side of each trial lens gives the angle of the cone.

The function of the temporal radius is to reduce lid interference at the temporal side of the lens. The temporal section is a spherical section flowing from the cone on the temporal side. The radius of this spherical section is the second variable and in the trial set varies as 12.0 mm., 12.6 mm., 13.2 mm. and 13.8 mm. Each of these is written as 20, 26, 32 and 38 respectively and is so inscribed on the lens.

The contact lens is varied in a third manner, viz: by diameter or "Size Eye." The function of the Size Eye is to aid in reducing lid interference to a minimum, and to aid in the cosmetic affect of the lenses. The lenses in the series are either Standard Size Eye, or —2 or +2, i.e. 2 mm. smaller, or 2 mm. larger in over-all diameter respectively. Each lens is appropriately inscribed.

In addition there is inscribed on the nasal or narrow side of the lens the refractive Rx present in that trial lens.

SUMMARY OF THE OBJECTIVE FITTING TECHNIQUE

After preliminary inspection of the size of the palpebral aperture, the tightness of the lids, and the degree of exo or enophalmus, an ap-

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proximate determination is made by inspecting the eyeball, of the angle of the cone, temporal radius and size eye required.

This lens is gently inserted in the right eye with a 1½% Bicarbonate of Soda Solution, together with a drop of Fluorescein, used here as an indicator. With the aid of a flourescein lamp, it is possibly to clinically determine precisely whether adequate corneal and limbal clearance exists. The desired situation seems to be complete corneal clearance and from 2-3 mm. limbal clearance while the eye is in the primary position. Moderate corneal touch in other than the primary position apparently does not affect either the comfort, wearing time or tissues.

If the proper clearance is not obtained with the first lens, then changes are made as required, i.e. using a larger angle of cone to get less clearance and a smaller angle to obtain more clearance.

Inspection of the temporal radius easily determines whether the fit is satisfactory, i.e. the edge rests on the eye without undue tightness or blanching of the blood vessels.

Inspection of the quadrant encompassing the superior, superior-nasal, and nasal edges is made to insure that contact is being made along the inside of the cone and not along the edges. Where necessary the angle of the cone is changed to avoid edge tightness.

Extreme looseness is permitted in these three sections within the limits that there be no loss of liquid and no sensation due to loose edges. The nature of the forces of the lids acting on the lens in these areas, permits of considerable looseness. Such is not the case on the temporal side, for looseness there can practically never be tolerated.

SUMMARY OF THE SUBJECTIVE FITTING TECHNIQUE

When the proper objective fit is obtained, the lens is reinserted with simple 1½% Bicarbonate of Soda Solution. The patient is then requested to open and close his eyes rapidly and move the eyes to the extreme nasal and temporal side. While so doing, he is asked to differentiate between any sensation at either the temporal or nasal edges. It is important to note here that with a proper objective fit, all remaining sensations are almost inevitably due to lid irritation.

Any significant sensations temporally are treated by either reducing the size of the Temporal Radius or by increasing the Size Eye. This increase in size eye simply brings the temporal edges further back into the eye and so reduces lid interference.

Any significant sensations nasally are treated by either reducing the angle of the cone and by decreasing or increasing the Size Eye.

Where the nasal edges are too loose and so irritate the lids, the angle of the cone is reduced. Where the nasal edge strikes the Plica too soon or too strongly as the eye moves nasally, the size eye is reduced. Where the edge is too short and so irritates the lids, the size eye is increased.

Usually these small changes from one lens to another are all made in the first visit. When an adequate lens has been selected for the Right eye, the same lens is then inserted with 1½% Bicarbonate of Soda Solution and a drop of Fluorescein in the Left eye. In nine cases out of ten this lens will adequately fit the left eye. Where necessary suitable changes are made in the left lens until a proper Objective and Subjective fit is obtained.

Provided no unfavorable condition exists, such as extreme lid tightness, or undue nervousness, and provided that the tissues have not been irritated as a result of the insertion and removal of the several lenses, the patient is expected to wear both lenses in the first visit or shortly thereafter for a full four hour period with comfort.

The subjective criterion of a properly fitting pair of contact lenses is the wearing of these lenses for a full four hour period. A subsequent refraction with the trial contact lenses in place and two or more practice periods in teaching the patient how to insert and remove the lenses constitue the principles of the fitting procedure.

THE 500 CASES FITTED WITH FEINCONE CONTACT LENSES.

One of the purposes of the study was to analyze a random sample of fitted contact lens cases in order to determine whether the series selected as a trial set adequately served clinically. The cases analyzed in this paper were those of optometrists other than the writer, each of whom had been in contact lens practice for a minimum of six months, to a maximum of ten years. The cases were chosen from only 26 practitioners covering a period somewhat less than three months. The records were obtained from the laboratory and represent the lens sizes of finished prescription lenses prescribed only after a full four hour wearing time. These optometrists in private practice are distributed in the Middle Atlantic States and up to the Mississippi River.

Table I gives the frequency of each of the lenses used in the 1,000 eyes. The frequency may be read directly as per cent by placing the decimal before the last digit; thus the lens 43 26 is shown in the frequency column as 224 which then equals 22.4%.

CLINICAL RESULTS WITH FEINCONE CONTACT LENSES

Table 1—Frequency of Contact Lens Sizes in 1000 Eyes

#	Contact Lens Size	Frequency		#	Contact Lens Size	Frequency
1	4326	224		21	4620—2	10
2	4326—2	93		22	4626+2	9
3	4626	89		23	4638+2	9
4	4632	87		24	4026	9
5	4332	75		25	49x26+2	9
				26	4632—2	6
	Sub Total		568	27	49x38+4	4
6	4638	42		28	4320+2	4
7	49x32	39		29	4020+2	2
8	4320	36		30	49x44	2
9	4326+2	33		31	4026+2	2
10	4332+2	29		32	49x26—2	2
				33	49x20	2
	Sub Total		747	34	4314	2
11	4632+2	24		35	49x20—2	2
12	4338	21		36	4620+2	2
13	4320—2	19				
14	4338+2	19			Total	1000
15	49x32+2	19				
16	49x26	19				
17	49x38	16				
18	49x38+2	15				
19	4626—2	13				
20	4620	12				
	Sub Total		924			

It is apparent from the table that 43 26 is the most "popular size." Further, that:

1. 5 lenses fitted 57% of the cases
2. 10 lenses fitted 75% of the cases
3. 20 lenses fitted 92% of the cases
4. 36 lenses fitted 100% of the cases

TABLE 2 — SIMILARITY AND DIFFERENCES IN THE CONTACT LENS SIZES BETWEEN THE RIGHT AND LEFT EYE

Number of cases where each of both eyes required the same Contact Lens Size=449 or 89.8%.

Number of cases where Right and Left eye were different=51 or 10.2%.

TABLE 2 showing nature and frequency of difference in each of the variables between the Right and Left eye.

No.	Nature of Difference	Frequency
1	Temporary Radius only	27
2	Angle of Cone only	10
3	Size Eye only	6
4	Angle of Cone and Temporal Radius	5
5	Temporal Radius and Size Eye	2
6	Angle of Cone, Temporal Radius and Size Eye	1
	Total	51

TABLE 3—FREQUENCY OF ANGLE OF CONE

No.	Angle of Cone	Frequency
1	43	555
2	46	303
3	49	129
4	40	13
	Total	1000

TABLE 4—FREQUENCY OF TEMPORAL RADIUS

No.	Temporal Radius	Frequency
1	14	2
2	20	89
3	26	502
4	32	279
5	38	126
6	44	2
		1000

TABLE 5—FREQENCY OF SIZE EYE

No.	Size Eye	Frequency
1	—2	145
2	Standard	675
3	+2	176
4	+4	4
	Total	1000

In Fig. 1 the above Tables 3, 4 and 5 are represented graphically.

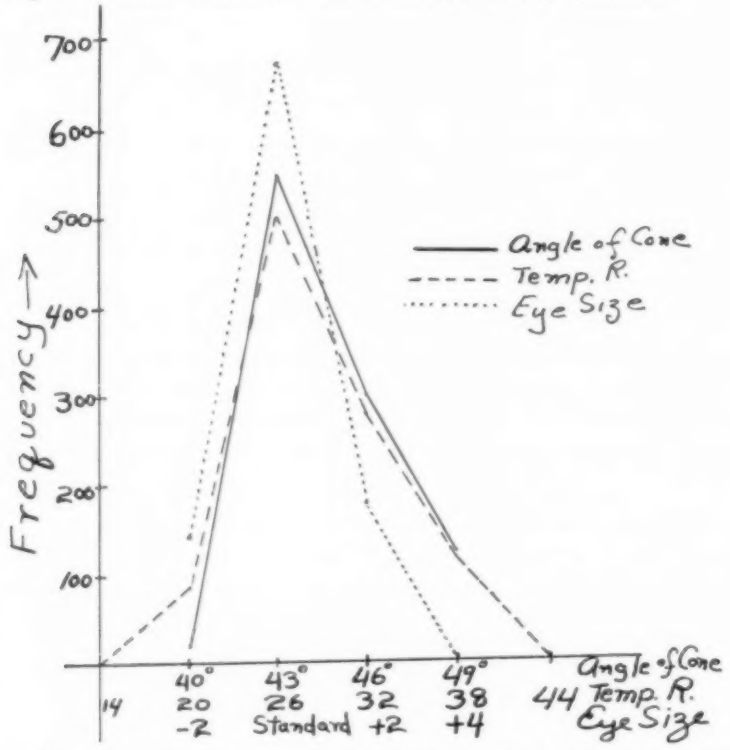

Figure 1. Solid line shows frequency of Angle of Cone: Dashed line shows frequency of Temporal Radius. and Dotted line frequency of Eye Size.

SUMMARY

A trial set series of contact lenses is described wherein each lens has three variables: (1) Angle of Cone, (2) Temporal Radius and (3) Size Eye. In the series each of these variables is permitted to vary between necessary limits. The principles of an Objective and Subjective technique are described for applying this series clinically.

A statistical analysis is made of a sampling of 1,000 eyes successfully fitted with this series. The analysis shows:

1. The required limits of each variable.
2. The frequency of each of the variables.
3. The frequency of combination of the three variables.
4. The inter-relationship of the variables.

Conclusions are drawn that:

1. Five lenses in the saries fitted 57% of the cases.
2. Ten lenses fitted 75% of the cases.
3. Twenty lenses fitted 92% of the cases.
4. In 90% of the cases, the same size lens fitted both the right and left eye.

NOTES ON ACCOMMODATIVE TRAINING PROCEDURES*

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Accommodative Training Procedures should be divided into two parts: procedures for testing and procedures for training. It would be futile to attempt any training without knowing the present condition as compared with possible goals to be achieved.

Studies of accommodative response make apparent the ability of the subject to change the posture of accommodation easily and quickly within the standard range of ability. This should not be confused with tests for amplitude of accommodation. The two are different proceddures, having different controls and giving information regarding quite different abilities.

There is quite ample clinical evidence to substantiate the idea that when accommodative rock is sub-standard, there is every reason to believe that a visual problem is the cause of the failure and that a removal of the visual problem is indicated.

The object in taking accommodative rock is to ascertain whether there is any interference in the integrity of the accommodative response due to distortions in the adjuster patterns and relations to the central nervous system. There is certainly a very definite and quite substantial change in the posture of the accommodative mechanism when vision is redirected from the far point to the near point. This statement takes into full consideration that accommodation may be a cilio-retinal-cortical action.

Accommodative response or rock can be taken quantitatively on certain patients having no crystalline lens. When the lens has been removed surgically the existence of accommodative rock in a measurable degree and of respectable magnitude would seem to substantiate the idea that accommodation was in small part at least a retinal, perhaps a cortical ability. When the external stimulus is changed there should be an immediate and correctly gaged response in the total posture of accommodation.

When accommodation can be changed to permit interpretation at

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any given point in space, then such change should be capable of being immediately made effective. If there is a lag or an insufficiency in the measurable response, that failure must seemingly be attributed to failures in the harmonious relations between the controlling patterns in the central nervous system. It is upon this platform of assumptions that the procedures for the taking of accommodative rock is placed.

The instrumentation generally used for this procedure is any stereoscopic device which will handle split cards or targets and having lens wells to facilitate the use of lens powers other than those incorporated in the instrument. The same measurements may be made equally well with a refractor and the proper targets with or without the use of a reading rod.

Illustratively, a tele-binocular will be used with the subject seated before the instrument and the head properly leveled for the instrument; select a pair of photographically reduced Snellen cards, place in the card holder in the orthophoric position or with a separation of 95 mm. Place the card holder at infinity or zero on the shaft with the patients present correction in place, if one is worn, and ask if all the type can be read and if not, ascertain the smallest type that is readable. Occlude first one eye and then the other, thus determining the similarity in acuity for each eye with this test. In the event the 20/20 line cannot be read by either or both eyes, the targets are moved up the shaft until the desired line can be read with the poorer eye. In the event of amblyopia of a very large amount or the inability to see with one eye, a monocular amplitude can be arived at by following the to be indicated procedure for the good eye. Where reasonable acuity is present for both eyes, convex spheres are then added before the eye with the best acuity until 20/20 is still visible, but any slight addition of plus would blur it. During the time these adjustments are being made the patient becomes familiar with the alternate covering and uncovering of first one eye and then the other. Then with one eye occluded a —2.00D. Sphere is placed in the lens holder before that eye. The occluder is quickly switched to the other eye and the subject asked, "Are the letters equally readable?" The phraseology of the question is important because one eye and then the other should make the adjustment, despite the consensuality of accommodative behavior. The interpretation of the print is expected to be similar. Minus lenses increase the density or blackness of print viewed through them. This is not a criteria and has no bearing on the test.

A report by the subject in the affirmative assures the observer of

a normal response. The occluder is then switched to the other eye and the question repeated. The eyes have demonstrated their ability to change the point of focus by clearing the expected print, first through the —2.00D. Sphere and then without any lens before the eye. The minus lens is then placed before the other eye and the procedure repeated. A rock with minus two to plano and the reverse by each eye is recognized as adequate clinically.

In the event a rock of this amount cannot be demonstrated, a lens of half diopter less in amount is used and the test repeated, and so on if necessary, to such an amount as the patient is capable of handling.

In certain instances it will also be noted that the abilities of the two eyes in handling the problems of this test will be unequal. Possible reasons for this inequality may be discovered by other investigations. Certainly the emphasis and subsequent training procedures will be influenced by such differences.

In the event the operator chooses to make this test with a tele-eye-trainer comparable results may be expected, using Rotor No. 4 (6 sec. on and 1½ sec. off).

If the observer's choice of instrumentation is a refractor, two choices are available: first, have the patient view 20/20 Snellen at distance, equalize vision and proceed as indicated; second, place reduced Snellen at 16 in. on the reading rod, insert a pair of +2.50D. Spheres to neutralize the working distance and vary if necessary to equalize vision. Then use the indicated procedure as already outlined.

It is apparent that this investigation by any of the procedures would indicate how skillfully, quickly and effectively the subject could posture accommodation.

In the event of other than a normal response and if in the wisdom of the operator, training technique should be instituted, consideration will be given to the possible means of making alterations in the facility of accommodation.

The purpose is to reestablish the smooth participation of the adjusto-effector-arc of accommodation to the normal focus requirements within the probable expected range of use.

Regarding the muscular activities of the eye, Lancaster had this to say in Archives of Ophthalmology. "Of the eyes it must be remembered that the muscles simply and faithfully carry out the orders brought in by the nerves. The nerves in their turn simply transmit the orders or impulses from the neuclei and the neuclei in their turn, issue only such orders to contract or relax as the higher centers send to them."

The clinical investigation of visual ability has made use of the philosophy and this is particularly true considering accommodation; of demanding a normal reaction and lessening the demand as may be indicated by individual ability. In considering training the reverse is true, that the start of any indicated training procedure is from within the ability of the patient. Other points to be considered are to keep the training periods brief as accommodative training fatigues the patient quite easly. Avoid the practice of errors, that is allowing the subject to work in a blur. Secure a proper attentive posture and head arrangement before the instrument. Equalize as nearly as possible the vision at the outset of each period of training. In instances of marked slowness in the ability to change, accommodation from far to near, initial training should be with a tele-eye-binocular with hand occluders. This allows for a more extended viewing of each target.

Specific technique, concave or stimulative phase. Equipment — tele-eye-trainer, slide holder at infinity, Rotor No. 4 (6 sec. on and 1½ sec. off) or No. 5. (6 sec. flash on the minus side 9 sec. flash on the plano side). If minus lens is on the right eye, transposing switch turn to L, and if minus lens is on the left eye, it is turned to R. All buttons up simultaneous switch off, targets reduced Snellen, childrens yarns, essays or specially prepared targets. Keep the slide chambers closed and work in a room with subdued light if possible.

Start the motor and request the patient to read aloud the smallest line on the reduced Snellen or first line of print if other targets are used. Be assured that he is distinguishing print before each eye on the reduced Snellen. When he can go no further, make a note of the last line which he has read correctly on each side. The seventh row is standard for computing the patient's progress. At the close of each training session when fewer lines are read with one eye, take the last line distinguished by it as the basis for calculation. When the light is on the right side place a minus sphere in the left lens holder; when the light flashes on the left side ask whether the same line as before can be read, and again when the light is on the right, ask whether the same line can be read as before. If this can be done in each case, remove the lens while the light is off and place it in the right lens holder. Again question the patient as before and if the smallest line formerly read is seen satisfactorily on each side remove the lens during a dark interval and when the light is on the right side, place a —0.50 D. Sphere in the left lens holder. Continue questioning the patient, changing the lens to the other eye as before and as long as the patient is able to read the control line, increase

the lens to the next higher one by quarter diopters steps. When in answer to your question, the patient reports that he does not read the indicated line or that he reads it but it is blurred, ask him when the light next flashes on that side, whether the line is now clear. If he reports that it is not, repeat the question on the following flash for that side. Then if the line fails to clear go back to the preceding lens and change it from side to side at intervals. Here, the reading slides R3-4 & 7-8 and R311-312, 317-318 to 333-334 or other reading slides such as yarns, essays or prepared targets may be used to advantage. Record the lens of greatest power to which the eye has responded satisfactorily as the amount of accommodative rock at that time. Start the second period of training by selecting a lens just below the one recorded as the accommodative rock for the proceding period or if necessary drop back to such a lens combinations as can just be handled by the patient. When assured that both eyes have clear vision, proceed as before in increasing the power of the minus lens.

Alternate instrumentation; tele-eye-binocular,—proceed as above having the patient alternately cover one side of the lens housing and then the other with occluders: this technique is especially useful for patients experiencing great difficulty with even small amounts of minus Spheres.

Rotoscope;—reduced Snellen or fine detail targets, covering the eyes alternately as indicated above.

Refractor;—smallest readable print at 20 ft. Use occluders and lens in the instrument.

Stero-orthopter;—Targets C11 or C12. With this instrument if the patient is under 30 years of age no special lenses are needed in the instrument; over 30 a plus 3.50 compensation lens is used. Illumination switch is set at on; control lever set at easiest fusion position; motor is set at slow speed and concave lens are used as indicated in the routine of the tele-eye trainer.

A type of cards which has been found quite effective with the stereoscope are those developed by Parkins. The essential difference from the regular stereometric reading cards is the placing of colored markings above and below certain of the letters. With them it is unnecessary to use either minus or plus spheres. They are particularly useful on those patients showing measurable progress.

Procedures not requiring specific instrumentation: Jensen technique;—in this procedure the patient looks at a distant chart and places a minus two, three or four diopter lens before one eye, the other being

occluded. If the patient is unable to read the chart, the chart is brought nearer until the proper line can be read, after which the lens is moved aside. Repeat and alternate.

Hersch device:—Constructed from two trial frames with the bridge and the eye wire of one soldered to the eye wire of the other. The three cells are then mounted to a handle. An opaque disc is inserted in the middle cell, a plus or minus lens in desirable amounts in either of the outside lens holder. The patient changes the position of the device at stated intervals so as to expose the target or printed material, first to one eye and then the other. The opaque disc constantly serves as an occluder to one eye or the other.

Trombone technique:—The patient is provided with a reading card, having small print; one eye is covered, the card is moved slowly toward the patient with instructions that every effort be made to keep it clear and legible. When no longer able to clear the blur to a point of readability the patient is then instructed to lower the card and look at a predetermined object at infinity. As a rule four to six attempts before each eye is the limit for most patients.

Adequate performance has age as a factor. The pre-presbyope should perform with a minimum of —2.00 to —2.50 D. Sphere and every effort should be made to bring this up to —4.00 D. Sphere. For patients of from 40 to 45 years a maximum of —3.50; ages 45 to 50 a maximum of —2.50; ages 50 to 55—1.75; ages 55 to 60—1.00 and over 60 minus 0.50 D. Sphere.

Plus or inhibitive phase. Instrumentation tele-eye-trainer. Slide carrier at 2.50—16; Rotor No. 4; all buttons up, simultaneous switch on, charts reduced Snellen and reading slides as used in the stimulative phase. Targets moved in 16 mm. each. Maximum readable plus before one eye and alternated. A frequently employed aid is the moving of the carrier away as this helps increase the plus. A plus 2.50 is recognized as adequate in pre-presbyopes and a markedly smaller amount as age increases.

The training of accommodation is an integral part of any visual training program and because accommodative facility is of major importance to the individual, is used near the outset by most operators. Not a small part of its value is directional as determined by other investigations of the patient's needs.

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THE BALTIMORE PROJECT

As chairman of the Orthoptic Section of the Academy for the year 1945, I have been asked to comment on the two published reports of the so-called "Baltimore Project." Without a doubt, everyone interested has by now read the two articles, "The Baltimore Myopia Control Project" by H. Ward Ewalt, Jr. O. D. published in the January, 1946 issue of the JOURNAL OF THE AMERICAN OPTOMETRIC ASSOCIATION and "Report from the Wilmer Institute on the Results Obtained in the Treatment of Myopia by Visual Training" by Alan C.

Woods, M.D. published in the TRANSACTIONS OF THE AMERICAN ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY for November-December, 1945.

Here we have two sets of statistics. The optometrists who have never engaged in visual training from the standpoint of increasing the acuity of myopes will hail the medical report as justification of their procedure. The optometrists who have in their files many cases with more spectacular results than those indicated in the optometric charts (since office practice works on selected cases) will rejoice in that report as substantiation of their procedure.

To optometrists who have been perturbed about the variation of the two articles, several facts should be pointed out. It seems that the cases were not selected by the optometrists as was stated or implied in the medical report. The writer was not present in Baltimore at any time, but an associate was present during the entire time.

She states that the cases were recruited by the Curtis Publishing Company and were selected by the medical group. The optometrists in charge were not allowed to reject any cases and had no voice in their selection. Whether this was wise or not is beside the point, the fact of the matter is that these were wholly unselected cases from the optometric standpoint. In spite of this, the medical report admits a gain in 30 cases of 24.7% on the right eye and 29.3% on the left on the second examination; a fact overlooked by those who have peculiarly taken this project as an excuse for attacking those in charge of the project. We should like to point out that the three months given to the project included time for examination, skills and fields on all 100 cases, so that the actual training was done in less than three months. From experience, of the writer of this article, there is no reason to believe that at least these thirty and possibly more would have shown an additional gain if training could have been continued, as it would have been in office practice. Had the medical report been based on these findings, they would have had to accede a significant gain. However, their final report was based on their conclusions at the end of another almost five months after training had been discontinued, and according to the medical report only the thirty who showed gains were notified to report for the final examination. Of these thirty, only nine presented themselves to the medical examiners for the third examination which gave to these nine a final average of 19.8% on the right and 17.4% on the left eye. The fact that only nine appeared was attributed by Dr. Woods to the fact that they "had either disappeared or had lost interest." Yet, just

two weeks later, 71 of the subjects came back for the third examination to the optometrists.

Dr. Alan C. Woods is the same Alan C. Woods who testified before the Military Affairs Committee in the hearing of our bill to commission optometrists in the Army. A re-reading of the transcript (which all optometrists received) is recommended.

Of particular significance to optometrists is the fact that both articles agreed that beneficial personality changes had taken place.

While it is true that the psychological value was not a part of the original project, yet it was of sufficient import that the medical report stated that it would be conceded that there was psychological improvement. This is, of course, of no statistical value as far as the original purpose of the project was concerned, being merely a by-product, but it becomes of great value to those within optometry who know that important remedial personality changes take place as the result of visual training. Any optometrist who has not experienced this in the practice of optometry is most unfortunate in the limitations of his practice.

By the very nature of the general situation, it is practically impossible for any but a totally disinterested party to comment or write about the two articles without prejudice. This has been obvious in all articles published so far and is equally true of the present writer.

Recognizing this fact, the article by Alan C. Woods, M.D. was submitted for review to a statistician who holds the Ph.D. degree, has taught statistics, and to whom the writer of this article was previously wholly unknown. (Name available upon request.)

His evaluation follows:

"The article, 'Report from the Wilmer Institute on the Results Obtained in the Treatment of Myopia by Visual Training,' written by Alan C. Woods, M.D. TRANSACTIONS OF THE AMERICAN ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY, November-December, 1945 has been read and the evaluation from the statistical point of view is as follows:

"The interpretation of the research first cannot be classified as a very academic or scientific study because of the lack of statistical treatment of the data and the lack of documentation. Conclusions are made not on statistical findings, but rather on subjective judgment.

"It is reported in the study that nearly 60% (59."%) of the cases selected showed improvement, this percentage is sizeable and consequently is statistically significant. Until the author can prove by research, investigation or documentation that Myopic subjects *not* given

exercises would improve their visual acuity as much as those given exercises, the method reported should be accepted as being the best available at the present time.

"It is recommended that the original data given in the paper be reanalyzed in terms of a distribution and either probable errors or standard errors be found depending upon the type of distribution. In so doing, one can then positively determine the degree of reliability of the percentage of increase or decrease as result of exercise in Myopic subjects."

It seems, then, that we must agree that until the doubters can present documentary evidence that the changes achieved could have been achieved equally well without training, the theoretical basis of the optometric approach must stand.

Two recommendations might be made to optometrists: First, that those who have an inclination to use this report as an excuse for attacking those in charge of the project might wait until an evaluation of both reports could be made by totally impartial statisticians. Second, to all optometrists who, through training, have given better vision and better lives to many of their patients, it is recommended that they go quietly on with their work leaving the controversy to others.

MARGUERITE EBERL.

TRANSACTIONS OF THE AMERICAN ACADEMY OF OPTOMETRY

A department devoted to announcements, reports, appointments, organization data, news professional problems and ideals, as these relate to the Academy

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ACADEMY RESEARCH GRANT MADE TO DARTMOUTH EYE INSTITUTE

A grant of $1000 has been made by the American Academy of Optometry to the Dartmouth Eye Intitsute, Hanover, New Hampshire. These funds are presented to assist Dr. Robert E. Bannon in a research project in which a study of refractive findings will be secured without and with a cycloplegic.

Dr. Bannon and his associates have examined several hundred patients without and with cycloplegics. In general two types of cycloplegics were used: for children atropine instilled three times per day for three days and for others homatropine and paredine was instilled and a refraction done one hour later. A thorough refraction, using the fogging

technique, preceded the instillation of the cycloplegic and the same type of tests were performed under cycloplegia. Therefore there is available for comparison and study the following data taken without and with cycloplegia. (1) Keratometric findings. (2) Retinoscopic findings. (3) Subjective findings. (4) Motility. (5) Accommodative data. Other data of importance are: (1) Age of patient. (2) Differences between non-cycloplegic and cycloplegic findings. (3) Prescriptions given. It is expected that a comparison of the findings in different age groups may be significant. It is also expected that motility findings without and with cycloplegia may be significant, and there is a possibility too, that aside from spherical differences found there may also be differences in the astigmatic corrections prescribed.

Besides the compilation of the data on a representative number of cases Dr. Bannon will review the literature on this subject. The grant by the Academy will provide clerical assistance in the work of this compilation.

It must be understood that there will be no effort made to make a case for or against the use of cycloplegics. The data will be presented and only scientific interpretations made.

The Academy considers it a privilege to assist Dr. Bannon in this work. The specialists at the Dartmouth Eye Institute have already made valued contributions to our sum of ocular knowledge and information and we look forward to their further efforts.

LOCAL CHAPTERS

The Iowa Chapter met at the Kirkwood Hotel, Des Moines, April 15. A new constitution and by-laws was presented and approved, after which the following officers were elected. Dr. George Warkentine, President; Dr. M. P. Gleason, Vice President and Dr. D. E. Grim, Secretary and Treasurer. Following the business session Dr. Robert E. Bannon of the Dartmouth Eye Institute, Hanover, New Hampshire, spoke on orthoptics.

The Michigan Chapter met at Lansing, April 25. At the business session Dr. W. L. Brown was elected President; Dr. D. C. Thompson, Vice President, and Dr. T. R. Bell, Secretary and Treasurer. Following the business session Dr. Harold M. Fisher of New York City spoke on the role of aniseikonia in optometric practice.

The New Jersey Chapter met at Hotel Stacy Trent in Trenton, May 5. Three new members were presented, these being Dr. Donald J.

Kratz, Dr. William C. Walton and Dr. M. R. Koslow. Dr. Julius Neumueller presided and introduced Dr. E. J. Giglio of Bernardsville, New Jersey, who spoke on orthoptics.

The Southern California Chapter met at the Los Angeles Athletic Club April 12. The President, Dr. Ernest A. Hutchinson, presided and introduced Dr. Arthur E. Hoare of Los Angeles who spoke on contact lenses, reviewing several of the techniques used in prescribing these aids to sub-normal vision and the types of lenses now being made.

The Vermont Chapter met at Rutland, April 15. A new constitution and by-laws was presented and approved and the chapter decided to invite qualified optometrists who practice in New Hampshire to meet with the Vermont Chapter. Dr. E. Craig Wilson presided.

ACADEMY COMMITTEE APPOINTMENTS

Dr. J. Fred Andreae, President of the American Academy of Optometry, has appointed the following members of the Academy to conduct the arrangements for the Annual Meeting of the Academy to be held at Philadelphia on December 1, 2, 3 and 4, 1946. Dr. D. G. Hummel, Program Chairman. Dr. J. Fred Andreae, Arrangements Director. Dr. W. Edward Dewey, Director of Sections. Dr. Clarence W Morris, Chairman of the Section on Pathology. Dr. Eugene Freeman Chairman of the Section on Contact Lenses, assisted by Dr. Arthur E Hoare and Dr. E. Adams. Dr. H. M. Fisher, Chairman of the Section on Aniseikonia, assisted by Dr. Robert E. Bannon and Dr. O. L. McCulloch. Dr. E. J. Margaretten, Chairman of the Section on Orthoptics assisted by Dr. M. T. Eberl. A Papers Committee has also been appointed by President Andreae, but the names of the members serving on this Committee are not publicly announced.

NEW MEMBERS OF THE ACADEMY

The following optometrists have been elected to Fellowship in the American Academy of Optometry during the quarter ending March 31, 1946. The Executive Council welcomes these new members.

Dr. L. Lester Beacher, 33 West 42nd St., New York 18, New York.

Dr. Dale E. Berkebile, 119 West 7th St., Rochester, Indiana.

Dr. James J. Curran, Twiggar Bldg., Ossining, New York.

Dr. Abraham L. Graubart, 150 Bennett Av., New York 3 New York.

Dr. Norman B. Hays, 717 Main St., Niagara Falls, New York.

Dr. Robert A. Major, 310 Methodist Bldg., Shelbyville, Indiana.

Dr. Samuel Mendell, 1361 Madison Av., New York 28, New York.

Dr. George W. Rand, 32 High St., Plymouth, New Hampshire.

Dr. Carl H. Scholermann, 20 Romer Av., Pleasantville, New York.

Dr. Rudolph T. Textor, Dartmouth Eye Institute, Hanover, New Hampshire.

Dr. Victor LeRoy Westpahl, 117½ West 4th St., Vinton, Iowa.

Dr. W. Zoltan, 393 George St., New Brunswick, New Jersey.

BOOK NOTICES

EYE PROTECTION AND VISUAL EFFICIENCY IN INDUSTRY. American Optical Company. 8-page brochure. Dec., 1945.

In the face of a growing awareness of the need for greater industrial eye protection and visual efficiency, and also a need for assistance and guidance in bringing this about, the American Optical Company outlines in this brochure its policy in relation to its two major customers —the Ophthalmic Professions and Industry.

Industry is ready for an aggresive program in the field of visual safety and efficiency, but the job can be done, according to the American Optical Company, only through complete teamwork between Industry and Ophthalmologists, Optometrists and Ophthalmic Dispensers. AO says it will do all in its power to encourage a formal working relationship between the two, and pledges complete support to the Ophthalmic Professions in the important task ahead. However, the Professions must, it is pointed out, acquaint Industry with the true values in eye care and make their services available wherever possible.

AO sets forth a written policy effective January 1, 1946 stating that they will not advocate any type of industrial visual efficiency or eye care program which in any way by-passes the services of the Ophthalmologist, the Optometrists, or the Ophthalmic Dispenser.

A. VIRGINIA HUCK.

DRIVER TRAINING REDUCES TRAFFIC ACCIDENTS ONE-HALF. Published by Traffic Engineering and Safety Department, American Automobile Association, Washington, D. C. 18 page brochure. 1945.

American Automobile Association made studies of the accident records from June 1939 to November 1941 of 1880 Cleveland High School students taking driver education and training courses and 1372 students receiving no such instruction. Also included is a study of 500 high school student drivers at State College, Pennsylvania. Results of these studies are shown in graph, table, and narrative form.

Comparisons were made between trained and untrained drivers; men and women drivers; drivers from various economic levels in home life; trained men with and without accident records; and untrained men with and without accident records.

General conclusions reached by AAA: (1) Training reduced number of accidents in which men were involved by one-half; (2) There is a definite need for general public education and specific training programs in driving.

A. VIRGINIA HUCK.

ANNOUNCEMENTS

PURDUE TO HOLD AN OPTOMETRIC SEMINAR

An Optometric Seminar on Industrial Vision will be held at Purdue University, LaFayette, Indiana, from June 3rd to June 9th, inclusive. The following subject material will be covered: Personnel Tests in Industry, Industrial Relations, Industrial Organizations and Functions, The Vision Program in Industry, Applications of Visual Standards, Vision and the Job, Professional Services and Cooperation, Vision Tests and Job Performance, and Professional Services and Optical Aids. Tuition fees for the course have been set at $50.00.

Teaching and housing facilities are available for thirty men. Optometrists wishing to attend should contact their State Chairman on Industrial Vision, or forward their applications directly to Dr. Joseph Tiffin, Industrial Vision Institute, Purdue University, LaFayette, Ind.

PENNSYLVANIA STATE COLLEGE OF OPTOMETRY

The second Refresher Course Class will enroll at the Pennsylvania State College of Optometry on June 17, 1946.

This six month course offers the opportunity for returning veteran optometrists, who have had their optometric practice interrupted, to review the theoetical and practical aspects of optometric practice. The

subjects include: Neuro-ocular anatomy, ocular pathology, visual fields, theoretical and clinical diagnostic procedure and techniques, orthoptics and visual training, ophthalmic mechanics, and office practice.

At the completion of the Refresher Course a certificate is awarded. Inquiries or requests for application blanks should be sent to the Registrar, Pennsylvania State College of Optometry, 12th Street and Spencer Avenue, Philadelphia 41, Pa.

To accommodate the number of applications for enrollment in the two weeks contact lens courses offered at the Pennsylvania State College of Optometry, two courses are being offered in the third session from May 20 to May 31 and from June 3 to June 14. Instruction is given in all methods of contact lens fitting, and upon completion of the course optometrists are qualified to begin fitting their own patients immediately.

The daily schedule of classes from 9 a.m. to 5 p.m. is divided into mornings of classroom lectures and afternoons of clinical practice. Those enrolled fit each other with contact lenses, as well as other practice patients, using both the trial case and molded types of lens with and without the use of anesthetics.

The subjects include: Anatomy of the Anterior Segment of the Eye and Its Appendages by O. G. Rybachok, M.A.; The Optics of Contact Lenses by F. A. Sinn, O.D.; Contact Lens Solutions by Jacob nevyas, Ph.D.; Ocular Pathology and the Materia Medica Relating to Contact Lenses by G. A. MacElree, O.D. The clinical work of fitting contact lenses is under the direction of John C. Neill, O.D., who has been teaching this subject since 1930.

Those interested in enrolling for one of the next two courses should write to the Registrar immediately for an application. Veterans who apply should make application at their local Veteran's Administration Office for educational benefits under the G.I. Bill of Rights.

NUPUF LABORATORIES CLINICS APPROVED

Nupuf Laboratories were officially approved March 20th as an Institute of Vocational Training for G.I. Optometrists who attend one of the 1946 Contact Lens Clinics. Optometrists wishing information should see their nearest Veteran's Administrator or write to Helen O. Medlin, c/o Nupuf Laboratories, P.O. Box 308, Canton, Ohio. Nupuf Laboratories are also approved for On-the-Job training and are increasing their laboratory personnel with returning veterans.

TEMPLE UNIVERSITY

The 1946 Annual Seminar on Developmental Reading will be conducted by the Reading Clinic Staff, Department of Psychology, Temple University, from June 24 to June 28, inclusive. Lectures, demonstrations, and discussions will be used to develop the central theme: *Differentiated Developmental Reading.*

Topics for the five successive days are: Appraisal and Development of Reading Readiness at All School Levels, Goals of Reading Instruction and the Discovery of Reading Levels and Specific Needs, Recreational Reading, Deveolpment of Basic Reading Skills Required for the Reading of Current Events and Content Subjects, Procedures for Differentiating Instruction within the Classroom. Sectional meetings are scheduled for elementary teachers, secondary teachers, school psychologists, remedial teachers, and speech teachers. Special meetings are sponsord by national organizations including the Association for Childhood Education, American Speech Correction Association, Department of Elementary School Principals, and Department of Supervision and Curriculum Development. Leading authorities in the field of reading will lecture, conduct seminars, and provide demonstrations.

Enrollment is limited by advanced registration, which must be verified before June 12, 1946. For copies of the program and other information regarding this one-week Institute, write to Dr. Emmet Albert Betts, Reading Clinic, Temple University, Philadelphia 22, Pa.

INDIANA CONTACT LENS SECTION MEETS

The organizational meeting of the Contact Lens Section of the Indiana Association of Optometrists was held at the Barnes Hotel in Logansport April 28th.

The first matter of business was the adoption of a constitution and by-laws for the section.

It was decided that the charter would remain open until January 1, 1947, by which time those who desired membership would meet the requirements of the membership committee of the section. These rules have not been formulated as yet and will be published later.

The questionable type of press releases that are being issued by some manufacturers of contact lenses came in for considerable discussion. Out of this discussion came the following resolution:

Whereas certain statements which violate accepted recognized ethical principles relative to Optometrists and contact lenses have appeared in the public press and

Whereas releases for the professional press from some contact lens manufacturers have appeared which also violate good taste, if not ethical principles, therefore be it hereby

Resolved that the Contact Lens Section of the Indiana Association of Optometrists hereby go on record as deploring those press releases for public or professional consumption relative to the fitting of contact lenses which violate recognized ethical principles, and be it further

Resolved that members of this section hereby make it known that they will cooperate only with those contact lens suppliers who adhere to recognized principles of ethics and good taste in any reference to the patient-optometrist relationship.

Dr. Eugene Freeman of Chicago took over the educational period to discuss the various aspects of collaboration with other professional people in fitting contact lenses. He stated, "The act of inserting a contact lens is fraught with more danger than the insertion of molding material." He stressed the need for consultation with an ophthalmologist when there were any contra-indications to the wearing of contact lenses.

Officers were elected as follows: Chairman, Dr. G. F. Kintner of Wabash who also acts as a member of the Department of Conservation of Vision of the Indiana Association of Optometrists; Vice-Chairman, Dr. D. O. Elliott, Jr., of South Bend; Secretary-Treasurer, Dr. H. C. Higgason of Elkhart.

The next section meeting will be held in conjunction with the summer convention of the Indiana Association of Optometrists which will be held at Terre Haute, June 9-10.

CALIFORNIA STATE ASSOCIATION OF OPTOMETRISTS

The 41st Annual Convention of the California State Association of Optometrists concluded its three-day meeting held at the Californian Hotel, Fresno, on Friday, Saturday and Sunday, April 5, 6 and 7, 1946.

The new officers elected are as follows: Dr. Harry C. Shepherd, President; Dr. Wm. W. Anderson, President-elect; Dr. Harvey Odell, Vice-President; Dr. W. U. Murrish, Treasurer; Dr. A. Burton Clark, Director of Education; Dr. Jay M. Hilligoss, Director of Organization; Dr. Lawrence H. Foster, Director of Public Information, and Dr. Pons who continues to serve on the Board of Directors as Immediate Past President.

The position of Executive Secretary of the State Association was established on a permanent basis and Paul Yarwood will continue in that office.

Governor Earl Warren addressed the Convention on the opening day and Attorney General Robert W. Kenny spoke at the banquet Saturday evening.

As for the educational features, Dr. Peter Spencer, Professor of Education, Claremont College, opened the first educational session by speaking on the subject "That Man May See." Dr. Meredith W.

Morgan, Jr., Professor of Optometry, University of California, spoke on the topic "Meaning of Clinical Data in the Lightproof Laboratory Measurements." "Bifocals, Trifocals, Adjusting and Fitting Frames and Mountings" was the subject of a talk made by Dr. Leslie W. Scown of the Los Angeles School of Optometry, and Mr. Edwin D. J. Fletcher of the California State Department of Motor Vehicles discussed "Vision and Motor Vehicle Problems."

SHEARD REPRESENTS MAYO FOUNDATION AT SEVERAL MEETINGS

Dr. Charles Sheard, Director of the Division of Physics and Biophysical Research of the Mayo Foundation of the Graduate School of the University of Minnesota, Rochester, Minn., gave a paper on the "Influence of Certain Phyiscal and Physiological Factors of Aero Medical Significance on the Rod and Cone Adaptation" before the Aero Medical Association of the United States, of which he is a member, at the annual meeting held just recently in Chicago.

In his presentation, he reviewed and summarized the results of his own series of investigations in this field during the period of the war and pointed out that the chief factors which affected the level of night vision, if the subjects were normal in their cone and rod responses, were vasodilating (favorable) and vasoconstricting (unfavorable) agents, respectively, or corresponding effects produced by physical or physiological environments. Also, Dr. Bateman, one of his associates in the Mayo Aero Medical Unit, and he presented their work on "The Effects of Pressure Breathing on the Skin Temperature and Circulation of the Blood in the Extremities."

Dr. Sheard also was appointed the representative of the Mayo Foundation to meet with representatives from about twenty mid-western universities and to act as a member of the advisory council in connection with the operation of the Argonne Laboratory, which is the world's best equipped laboratory in nuclear physics and in which are housed the great sources of power for the production of artificial radioactive substances, many of which are being used now in medical treatment as well as "tracer" materials for use in such problems as sugar metabolism, the function of chlorophyll in the making of starches and other unsolved biological and biophysical problems.

During the month Dr. Sheard attended the three day session of the Council on Dental Therapeutics, of which he is a member and represents the basic science interests in dental practice and dental problems.

This Council consists of twelve members; six from the faculties of outstanding dental schools and colleges and six outstanding nationally known scientists concerned with such basic subjects and research as biochemistry, physiology and biophysics. Optometry might well consider the creation of such a Council, for it would bring into consultation in educational and research programs in optometry some of the best scientific talent of the country.

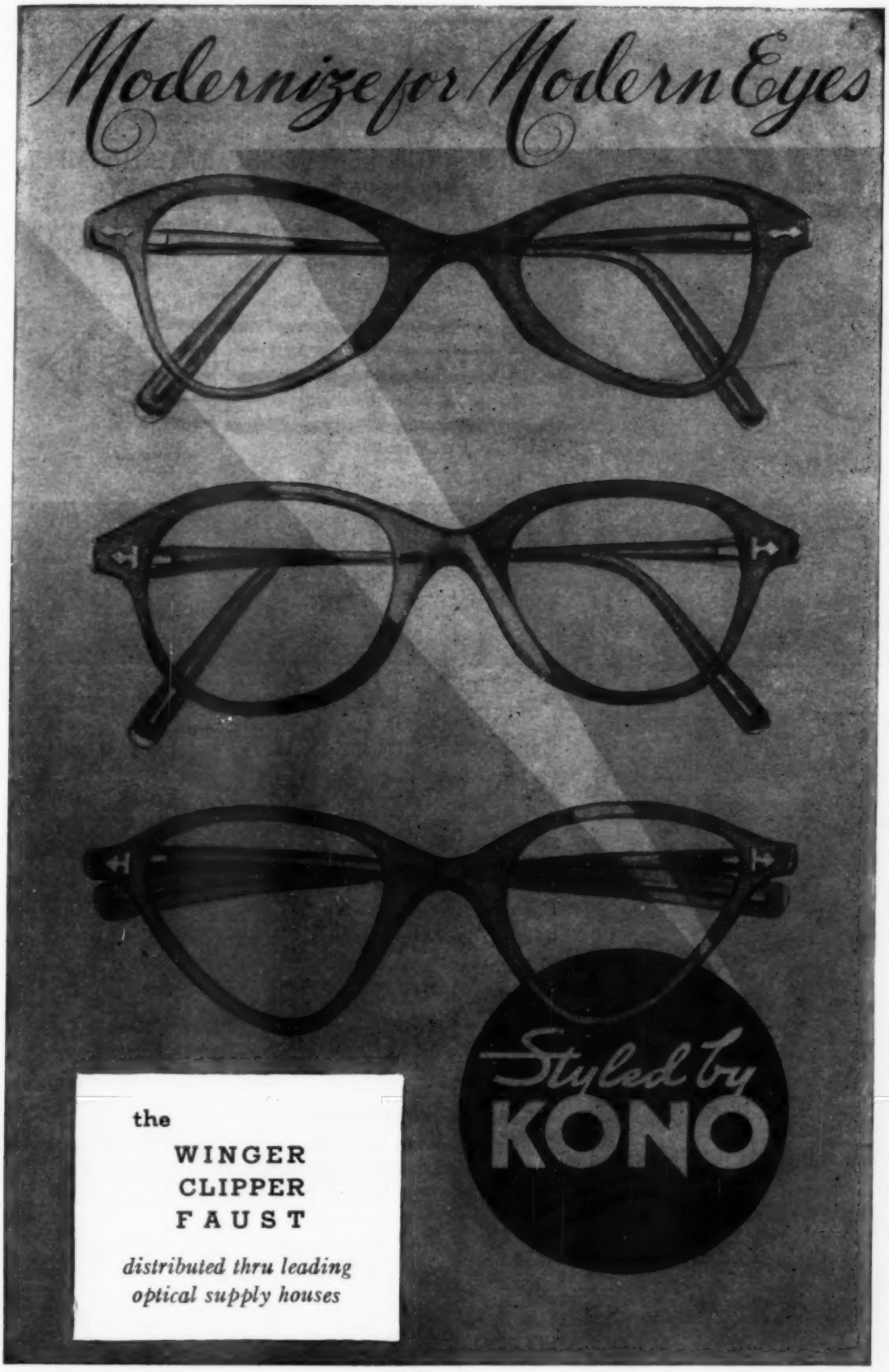
This week Dr. Sheard goes as the official delegate of the Optical Society of America to join with other delegates and representatives of America's outstanding universities and learned societies and to be present at the pre-inauguration lectures and the inauguration ceremonies of Dr. James L. Morrill as the President of the University of Minnesota.

PRECISION CONTACTS

Precision Contacts have now taken over the entire sixth floor of the Gateway Bank Building, 234 Hennepin Avenue, Minneapolis, Minn. Their expanded laboratory facilities will permit of increased production and prompter delivery service to optometrists.

Precision Contacts also maintain a contact lens manufacturing laboratory in the Park Central Building, Los Angeles, Calif. During recent years they have expanded their business to include customers from all over the world.

In addition to having a most modern laboratory, a complete research department is maintained for experimental work in solution and lens design. Research in contact lens solutions is being carried on with the aid of University of Minnesota research workers. Albert L. Anderson is managing director of Precision Contacts.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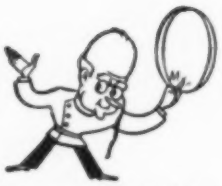

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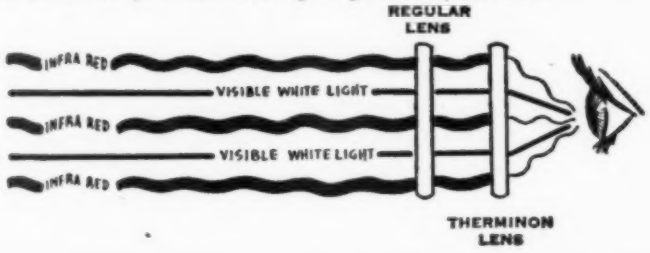

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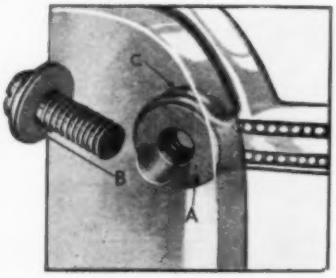

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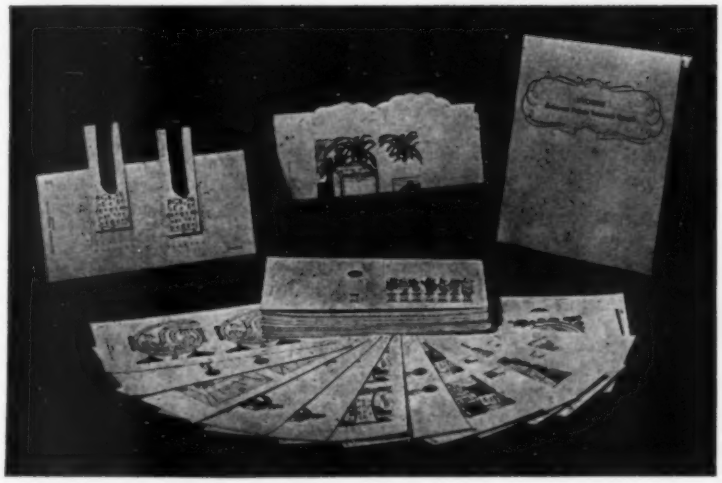
THE NEW DVORINE ANIMATED FUSION TRAINING CHARTS



These charts are designed for use with hand stereoscope for the measurement of lateral and vertical fusion amplitudes and for use, both in the office and at home, as a means of correcting strabismus, poor fusion, vertical imbalances, etc.

The following desirable features are found only in the DVORINE FUSION CHARTS:

(1) ANIMATION, (2) GAY COLORS, (3) LARGE SELECTION,

(4) VARIABLE DISTANCES, (5) VERTICAL FUSION DEVICE.

What one doctor writes: "This makes 5 sets that I have gotten from you. I find them very effective. Please send me two sets."

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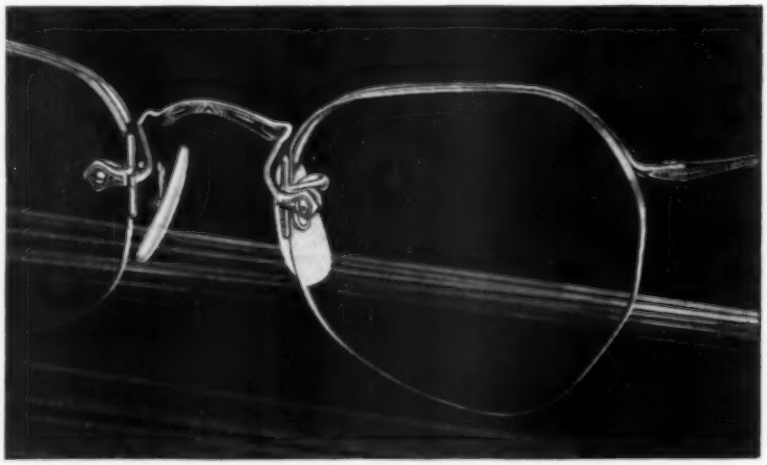

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